

WHAT IS CLAIMED IS:

1. An intelligent power module comprising:
 - power semiconductor switching devices;
 - driving means for driving said switching devices;
 - abnormal condition detecting means for detecting a fatal abnormal condition and a precursory abnormal condition thereof in said switching devices or said driving means;
 - protecting means for protecting said switching devices when said abnormal condition detecting means detects the abnormal condition; and
 - abnormal condition output means for outputting signals based on abnormal condition detecting signals outputted from said abnormal condition detecting means to outside;
- wherein said abnormal condition detecting means comprises:
 - an output terminal for outputting alarm signals when said abnormal condition detecting means detects the fatal abnormal condition; and
 - an output terminal for outputting abnormality factor discrimination signals indicating abnormality factors contributing to the fatal abnormal condition and the precursory abnormal condition.
2. An intelligent power module according to claim 1, wherein said abnormality factor discrimination signals are outputted as serial signals.

3. An intelligent power module according to claim 1, wherein said output terminal for outputting the alarm signals and said output terminal for outputting the abnormality factor discrimination signals are the same terminal.

4. An intelligent power module according to claim 1, wherein:

 said abnormality factor discrimination signals are outputted in synchronism with an abnormality factor output request signal inputted from outside.

5. An intelligent power module according to claim 4, wherein:

 said abnormality factor output request signal includes a transmission preparation signal having a predetermined cycle, said transmission preparation signal updating the abnormality factor discrimination signals stored in parallel-in/serial-out shift registers in said abnormal condition output means, and a read clock following said transmission preparation signal causes said shift registers to output the abnormality factor discrimination signals.

6. An intelligent power module according to claim 4, wherein:

 if said fatal abnormal condition is developed, said abnormal condition output means outputs alarm signals irrespective of whether said abnormality factor output request signal exists or not, and if said precursory abnormal condition is developed, said abnormal condition output means outputs the abnormality factor discrimination signals separately in time in synchronism with said abnormality factor output request signal.

7. An intelligent power module according to claim 1, wherein:

if said fatal abnormal condition is developed, said semiconductor switching devices cut off themselves.

8. An intelligent power module according to claim 1, wherein:

said semiconductor switching devices are connected in single-phase bridge connection.

9. An intelligent power module according to claim 1, wherein:

said semiconductor switching devices are connected in three-phase bridge connection.

10. An intelligent power module according to claim 8, wherein:

the abnormal condition detecting signals from said abnormal condition detecting means corresponding to semiconductor switching devices connected in bridge connection in an upper arm are transmitted to a lower arm through high voltage level shifters.

11. An intelligent power module according to claim 10, wherein:

said high voltage level shifters perform parallel transmission of multiple abnormal condition detecting signals.

12. An intelligent power module according to claim 10, wherein:
- said multiple abnormal condition detecting signals are encoded and are parallel transmitted by said high voltage level shifters.
13. An intelligent power module according to claim 10, wherein:
- said multiple abnormal condition detecting signals are converted into serial signals and are serial-transmitted by said high voltage level shifters.
14. An intelligent power module according to claim 9, wherein:
- the abnormal condition detecting signals from said abnormal condition detecting means corresponding to semiconductor switching devices connected in bridge connection in an upper arm are transmitted to a lower arm through high voltage level shifters.
15. An intelligent power module according to claim 14, wherein:
- said high voltage level shifters perform parallel transmission of multiple abnormal condition detecting signals.
16. An intelligent power module according to claim 14, wherein:
- said multiple abnormal condition detecting signals are encoded and are parallel transmitted by said high voltage level shifters.

17. An intelligent power module according to claim 14, wherein:

said multiple abnormal condition detecting signals are converted into serial signals and are serial-transmitted by said high voltage level shifters.

18. An intelligent power module comprising:

power semiconductor switching devices;

driving means for driving said switching devices;

abnormal condition detecting means for detecting a fatal abnormal condition and a precursory abnormal condition thereof in said switching devices or said driving means;

protecting means for protecting said switching devices when said abnormal condition detecting means detects the abnormal condition; and

abnormal condition output means for outputting signals based on abnormal condition detecting signals outputted from said abnormal condition detecting means to outside;

wherein said abnormal condition detecting means comprises:

an output terminal for outputting alarm signals when said abnormal condition detecting means detects the fatal abnormal condition; and

an output terminal for outputting warning signals when said abnormal condition detecting means detects the precursory abnormal condition; and

wherein abnormality factors are discriminated according to combinations of output signals from the respective output terminals.

19. An intelligent power module according to claim 18, wherein:

 said semiconductor switching devices are connected in bridge connection, and said alarm signals are generated by obtaining a logical sum of the abnormal condition detecting signals indicating the fatal abnormal condition from said abnormal condition detecting means corresponding to the semiconductor switching devices in an upper arm and the abnormal condition detecting signals indicating the fatal abnormal condition from said abnormal condition detecting means corresponding to the semiconductor switching devices in a lower arm; and

 said warning signals are generated by obtaining a logical sum of the abnormal condition detecting signals indicating the precursory abnormal conditions from said abnormal condition detecting means corresponding to the semiconductor switching devices in the upper arm and the abnormal condition detecting signals indicating the precursory abnormal condition from said abnormal condition detecting means corresponding to the semiconductor switching devices in the lower arm.